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PROBLEM-SOLVING OR PRACTICE IN THINKING. I¹

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Definite technique established.—During the past twenty-five years a definite technique of giving to pupils practice in problem-solving or thinking has been developed in progressive American elementary schools. It is the purpose of this series of articles to acquaint more teachers with this technique so that any skilled teacher who is a good thinker may give pupils practice in problem-solving and make them aware of the elements of skill in effective thinking. In order to show the importance and validity of the practices to be described we shall also discuss the place of problem-solving in everyday life and the ways in which great problem-solvers think.

Sections of the discussion.—We shall divide our discussion into four sections, as follows: I. Problems of everyday life. II. Actual lessons illustrating problem-solving in school. III. How skilled problem-solvers think. IV. Rules for training pupils in effective problem-solving.

I. PROBLEMS OF EVERYDAY LIFE

A problem is a question involving doubt. "To be or not to be."—For our purposes a problem may be defined as "a question involving doubt."² From this point of view the problem frame of mind is well depicted in Hamlet's famous lines beginning, "To be or not to be, that is the question." Whenever we thoughtfully search for means of dealing with any such doubt or perplexity or uncertainty or difficulty, we are engaged in reflective problem-solving. The problem may arise from some practical difficulty or from mere curious wondering about some unexplained or unusual fact. Such a practical problem as "Where shall I spend my

¹ This is the first of a series of articles on this topic.

² This definition is based on Webster's *International Dictionary*.

vacation?" often causes the most profound thinking and inquiry. Similar investigation is often entailed in deciding whether to go to college or to enter business. After one has decided upon a certain resort for his vacation or a certain school for his education, the clothes problem or baggage problem may become crucial. You may say to yourself, "To take a suitcase or a trunk, that is now the question." If a suitcase is decided upon, the problems may become very minute, such as, "To take this sweater or not, that is the question."

Large and small problems, from large policies to minute issues.—Thus we see that the practical problems of life may vary from momentous decisions, such as deciding upon a college education, down to such minute matters as pondering whether to take or leave a certain garment. In the larger responsible positions of life we find the same contrast between large and small problems. For example, a business executive has *large* matters of policy to determine, such as how to increase his business, or how to keep his salesmen full of "pep" and make them skilful in selling, etc. On the other hand, in his correspondence he solves scores of *small* problems each day, many of which involve merely a moment's glance at a letter and a half-minute's dictation of the answer. In the life of a school superintendent or principal or dean the same extremes occur. For example, at one time when I was "deaning" I had the following *large* problems: (1) How to discover a talented young man to become my successor as dean. To solve this required three years of exploration. (2) How to improve the annual catalogue, so that it would be more easily read by entering students. This required occasional editorial pondering during four years. (3) How to reconstruct certain rooms so as to provide more offices for an increasing faculty. Securing satisfactory plans for remodeling two particular rooms took several months of occasional planning. At the opposite extremes were the small, short problems of advising students who were registering. On registration days from twenty-five to forty students were advised. Each case usually took from one to ten minutes and was determined in the light of such questions as: (1) What is the student planning to do in life? (2) What are her

special talents? (3) What has been her previous training? (4) What required courses does she have to take? (5) What courses are offered that will meet her needs? (6) How can conflicts of hours be avoided?

Need of training in both short problem-solving and prolonged patient thinking.—The relative proportion of large and small problems in life will influence our plans for organizing opportunities for problem-solving in school. It is my impression that the small, short problems play such a prominent part in the daily life of most persons that we are justified in organizing in school thousands of such problems, each of which may consume only from one to ten minutes in its solution. At the same time we should provide for solution large problems which may puzzle the students for one hour or many hours, and thus train them to do the prolonged, patient thinking that is required in the larger, longer problems of later life.

Practical versus speculative problems; "The Lady or the Tiger."—Up to this point our examples of problems have all been of a *practical* nature in the sense that they related to practical plans or actions, usually of the person who was solving them. It is important to realize, however, that much problem-solving thinking in daily life is concerned with purely theoretical or speculative questions, the answers to which are *not* needed by the thinker in order to determine some important line of practical activity. To take an extreme example, some years ago Frank Stockton, the well-known writer, published a puzzling story called "The Lady or the Tiger." This story tells of a lowborn hero who dares to woo a princess. The king opposes the match and casts the hero into the arena, where he must choose between two doors. If he opens one, a tiger will come out and devour him. If he chooses the other, a woman whom he must then marry will appear. The princess, in the balcony, knows the secret of the doors. She gives her hero lover a sign and he opens one of them. The story ends with the question, which comes out—"The Lady or the Tiger?"

Girls puzzle over princess' choice.—When this unexpected puzzling ending to the story appeared, the country got into a turmoil of discussion in an effort to solve the problem. I watched a class

of high-school Freshmen recently discussing it. One girl said she had read every line about the princess eleven times in an effort to determine whether the princess' love and jealousy would lead her to indicate the door of the lady or the door of the tiger.

Playful speculation abounds in politics, religion, and science.—Other examples of such irresponsible problem-solving occur in politics, religion, and science. The chief mental recreation of many persons consists in puzzling over the political issues of the day, issues that are often so remote that the thinkers have absolutely no possibility of modifying matters in a practical way. Arguments about the Bible are often of a similar unpractical character. Finally, in the realm of science we find all types of inquiring persons, from the young boy who puzzles over pollywogs and electrical bells and flying machines, up to the advanced astronomer who tries to locate a new comet or planet—all concerned merely with "Why does it do that?" or "How does the thing work?" or "Where is the planet that explains these gaps in our calculations?"

Playful puzzling may train for practical problem-solving.—Often such playful puzzling proves of value to the problem-solver and to society. For example, the adolescent girls who puzzled about love and jealousy as exemplified in Stockton's princess probably were acquiring knowledge and skill in judging some of the most crucial issues of life; issues to which we find our greatest novelists and dramatists devoting their best talents. Similarly, the inquiring reader who ponders with interest political issues that do not concern him in a practical way is acquiring knowledge and skill which may help him in arriving at sound decisions upon political issues in which he does have a voice. The way in which playful, theoretical, or speculative problem-solving thus prepares for practical problem-solving is merely one example of the way in which play in general trains for serious activities. Dogs play at running, catching, biting, and fighting and are thus prepared for the real fighting and hunting of life. Men, women, and children play at puzzling out all kinds of interesting problems and may thus be trained and kept in condition for more serious problem-solving when this is required.

Great variety of problems in social life: mechanical, diplomatic, moral, expressional, aesthetic, scientific, mathematical.—The examples

discussed above have given us some notion of the varieties of problems found in everyday life. In order to extend our impressions of the many types of problems that exist, we may note the following partial classification of them.

1. *Mechanical construction problems, i.e., problems of how to make something.* These may vary from the small but very puzzling problem of how to "make over" an old garment, up to such a complex scientific problem as how to make a flying machine—a problem that puzzled the world for centuries. Many construction problems are now provided in elementary schools. It is important to notice that in the present chapter we are interested in the thoughtful planning and designing that enter into the solution of such problems, rather than in the actual mechanical construction.

2. *Transportation problems, i.e., problems of how to take or send something to some place.* These may vary from the simple personal problem of how to get a parcel to a friend around the corner up to the enormous transportation problems that confronted the Allies during the war. Such problems occur in all kinds of situations. For example, in department stores there is the problem of transporting the money from the salesmen to the cashiers. In large libraries enormous problems of human energy and convenience are involved in the stacking and arranging of books so as to render their transportation to readers swift and economical. In the courses in history, civics, geography, and science problems of transportation are being pondered more and more in progressive schools.

3. *Problems of personal relations, reactions, and influences, e.g.,* "Would Stockton's princess prefer to see her lover devoured by the tiger or to see him become the husband of another woman?" In daily life we are constantly pondering such human-nature problems. Often they are of a diplomatic character, e.g., how to influence our relatives, friends, and associates. Recently I pondered for two days how to present a business proposition to a certain man. At first I decided to write an outline of it, lay it before him, and explain it. On my way to see him, however, I decided that he so disliked listening to others that the only thing to do was to let him talk and then gradually insinuate my own proposals piecemeal, as occasion offered, during his conversation.

This proved successful. In all the social studies—history, civics, biography, literature, etc.—personal relations, reactions, and influences appear which offer opportunities for problematic discussions that train pupils in solving such human-nature problems when they are encountered in daily life.

4. *Problems of social organization*, such as “How shall we organize our literary society?” or “Which is better, for the government to own and operate the railroads or merely to control and supervise their operation?” From the simple organization of domestic activities up to such international organizations as the League of Nations we find thousands of problems under this heading. In the social studies, when properly taught, pupils are given training in planning, suggesting, criticizing, and evaluating solutions of such problems.

5. *Moral problems*, such as “Is it right for me to accept an education and services from my parents without making any immediate return in the form of home service?” Literature, biography, history, civics, and school activities are full of moral problems which especially competent teachers have pupils ponder and solve with benefit to their future powers of moral discrimination.

6. *Expressional problems*, e.g., “What is the best way to word my refusal of this invitation?” or “How shall I write this chapter?” In planning to write the present series of articles I pondered for weeks whether to open it with this section on problems of daily life or to open with actual lessons illustrating problem-solving in school. I finally decided to place the lessons as the second section, but I am not sure that this is the best order. Thus expressional problems vary from the simple choice of a word up to the large outlining and planning of a book or outlining a whole series of addresses. Training in expression in school thus offers one of the best opportunities for training in problem-solving.

7. *Artistic problems*, e.g., “What is the most pleasing arrangement of the pictures in this room?” or “What is the most pleasing way of massing the shrubbery in this park?” or “What is the most pleasing color scheme for this window display?” In the art courses reflective thought about such problems is now encouraged in many schools.

8. *Pure science problems*, e.g., "Why does the mist hang in clouds a short distance up the mountain, but disappear lower down?" or "Is the interior of the earth a molten mass or is it rigid and solid?" We are all familiar with such problems from our high-school science courses. In the grades, instruction in geography and science is being improved so as to offer increasing opportunities for pupils to puzzle out answers to scientific problems instead of merely learning scientific facts.

9. *Purely mathematical problems*, e.g., "How do I calculate the amount of income tax that I have to pay?" or "What is the best way of auditing the report of the treasurer of our society in order to verify his accounts?" Not only in arithmetic, but also in manual training, geography, science, and civics, pupils in progressive schools are being trained in puzzling out problems of arranging quantitative data and determining quantitative relations in order to prepare for the mathematically precise scientific method of problem-solving which is playing an ever-increasing part in solving modern civic, philanthropic, and business problems.

These examples suggest the large social value of training in problem-solving.—Several other types of problems could be described, but sufficient has probably been said to serve the purpose of this introductory article, namely, to give the reader a notion of the importance of the type of learning and training which we have under discussion. In discussions of handwriting and spelling it is possible to present the results of precise investigations showing just what degrees of handwriting skill and what spelling words are important in everyday life. For problem-solving we do not possess similar precise information, but our numerous examples up to this point have probably served to impress the reader with the frequency of the occasions for problem-solving in daily life, and the consequent desirability of training pupils to be skilful problem-solvers.

Origin of problems—in something puzzling, perplexing, confusing, disconcerting, unexpected, queer, strange, or odd.—Before proceeding to the discussion of sample lessons which illustrate the organization of such training it is desirable to get in mind the idea with which this article opened, namely, that a problem involves both a certain

intellectual and a certain emotional mental condition in the thinker; a problem is a question involving doubt. Consequently, for our purposes, a problem is not merely a *topic*, as it often appears to be in some courses of study, nor is it merely a question. It is a type of mental condition in the pupil, a condition in which he is possessed of a question plus doubt. The more doubtful, uncertain, and perplexed he is the more intense is his problematic frame of mind. Creating such a state of mind in the pupils, consequently, is the starting-point of problem-solving activity. Several words to describe this initial frame of mind have been brought together by Professor John Dewey, our leading authority on reflective thinking, in his excellent book entitled, *How We Think*. In one place (p. 12) he says, "The origin of thinking is in some perplexity, confusion or doubt." Again (on p. 74) he speaks of "something unexpected, queer, strange, funny [i.e., odd] or disconcerting" as furnishing the starting-point for reflective inquiry. Finally (on page 9) under the heading "the importance of uncertainty," he speaks of a "genuine *problem*" as existing in "whatever—no matter how slight and commonplace in character—perplexes and challenges the mind so that it makes belief at all uncertain."

Genuine problem for pupil when mentally challenged by something strange, perplexing, unexpected, or disconcerting.—From these terms we may derive a meaning for the rather ambiguous statement that has been current, namely, that the problem must be a problem for the pupil, not merely for the teacher. In terms of our discussion, this means that the starting-point for the pupil must be something—no matter how slight or commonplace in character—that puzzles or perplexes him; something that appears to him as unexpected, queer, strange, odd, or disconcerting. When his mind is challenged by such matters the pupil has a genuine problem. It may be practical or it may not. It may be merely something "funny" in the sense of being unexpected or strange; in fact, much of our most intense problem-solving thinking by adults and children occurs in response to just such "funny" unexplained phenomena.

Presented problems and discovered problems.—Sometimes problems are "presented" to a person in daily life, and at other times

he seems to "discover" them. The common use of the expression, "the problem then presented itself," suggests the frequency of the first type of appearance of a problem. Many mediocre thinkers never seem to feel a problem at all keenly unless it is vigorously "presented" to them by some obvious difficulty, such as missing a train or having no money to buy something to eat. They are perfectly complacent mentally except in the face of some such vital emergency. At the opposite extreme we find persons who are of such an inquiring frame of mind that they are continually poking around and turning up doubtful questions or problems in all kinds of unexpected places.

Presented problems abound in practical affairs.—In practical affairs we meet frequent occasions both for solving "presented" problems and for "discovering" problems. For example, a business executive or manager is "presented" with a batch of problems every time he reads his mail or listens to questions from his subordinates or customers. A busy executive solves scores of problems a day which are presented to him in this manner. One of the greatest elements of skill in executive work is the ability to decide rapidly many such problems as they are presented. Consequently, when we present pupils in school with many problems which they did not originate, but which they must solve rapidly, we are paralleling one of the most important types of problem-solving in practical life.

Discovering problems, illustrated by inquiring experts.—On the other hand, the discovering of problems is constantly illustrated in practical affairs when an expert examines a situation with a view to improving it. For example, a friend of mine has just taken over the management of a large business and one of the first questions he asked was, "When do you have your salesmen's meetings?" The old manager said they did not have any meetings, and was surprised when my friend pointed out that this was a serious defect in the organization. It is becoming more and more common to employ *consulting experts* (for example, in making school surveys) who visit a situation and by prying here and there with their questions uncover many problems which the "home folks" never

realized were there. The importance of organized training for this type of activity is stated by Judd when he says:

Not merely the solution of problems suggested by one's own experiences, then, constitutes the end and aim of school training, but the discovery of new problems is an important part of education. Youth is a period of learning to see problems as well as learning to solve problems.¹

Group discussions and individual solution.—Sometimes the problems which are thus presented or discovered are solved by an individual working alone, but frequently group discussion plays a very large part in the solution. Even where one individual does most of the thinking which attains the solution, he is often greatly aided by a few moments of discussion with someone else. In organized business and social life many of the crucial decisions, such as occur in undertaking new business ventures or passing new laws or trying cases in court, are reached only after many hours of problem-solving discussions by groups of persons. Hence, while it is important to train individual pupils in school in the solving of problems, it is equally important that they be given practice in problem-solving discussions so as to give them skill in this important social art.

Reflective problem-solvers to be trained, not impulsive ones.—Finally, before turning to the sample lessons which will illustrate how pupils are actually given practice in the art of problem-solving, we may note that we desire to produce *reflective* problem-solvers, not impulsive ones. To reflect means to turn the matter over in the mind, to view it from various angles, to consider carefully the various possibilities of solution. To develop skill in securing the true solution of problems by such reflective study is the topic of these articles. In the next instalment we shall describe sample lessons which show just how skilled teachers give such training.

[To be continued]

¹ C. H. Judd, "Initiative or the Discovery of Problems," *Elementary School Teacher*, XIII (1912), 153.